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Screening Level Ecological Risk Assessment

Screening Level Ecological Risk Assessment for the INEEL CERCLA Disposal Facility Complex (60% Design Component)

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Performer		Scott Perry/3190	Scott Perry	11/29/01
Checker	R	(Same as Independent Peer Reviewer)		
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ACRONYMS

ADE	average decay energy
AF	adjustment factor
ALC	acceptable leachate concentration
BAF	bioaccumulation factor
BDAC	Biotic Dose Assessment Committee
BCG	Biotic Concentration Guide
BW	body weight
CERCLA	Comprehensive Environmental Response and Compensation Liability Act
CF	concentration factor
COPC	contaminant of potential concern
CS	concentration of contaminant in soil
CSM	conceptual site model
CV	concentration of contaminant in vegetation
CWID	CERCLA Waste Inventory Database
DOE	Department of Energy
EBSL	ecologically based screening level
ED	exposure duration
EDF	Engineering Design File
ERA	ecological risk assessment
FA	fraction of decay energy absorbed
HI	hazard index
HQ	hazard quotient
ICDF	INEEL CERCLA Disposal Facility
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center

IR	ingestion rate
OU	operable unit
PP	percent prey
PS	percent soil
PUF	plant uptake factor
PV	percent vegetation
QCEL	quantified critical exposure level
RESL	Radiological and Environmental Sciences Laboratory
ROD	Record of Decision
SDA	Subsurface Disposal Area
SLERA	screening level ecological risk assessment
SLQ	screening level quotient
SSSTF	Staging, Storage, Sizing, and Treatment Facility
SUF	site usage factor
TCC	Typic-Camborthids-Typic Calciorthids
T/E	threatened and endangered
THQ	total hazard quotient
TRV	toxicity reference value
TSLQ	total screening level quotient
TTF	Typic Torrifluvents
WAG	waste area group
WI	water ingestion

Screening Level Ecological Risk Assessment for the INEEL CERCLA Disposal Facility Complex (60% Design Component)

The objective of this assessment is to determine the potential for adverse effects on ecological receptor populations, including protected wildlife species, as a result of exposure to the INEEL CERCLA Disposal Facility (ICDF) Complex. Figure 1 shows the location of INTEC within the Idaho National Engineering and Environmental Laboratory (INEEL). The U.S. Department of Energy (DOE) authorized a remedial design/remedial action of the INEEL including INTEC in accordance with the Waste Area Group (WAG) 3 Operable Unit (OU) 3-13 Record of Decision (ROD). The ROD requires contaminated surface soil be removed and disposed of on-Site in the ICDF. The ICDF Complex layout and location relative to the Idaho Nuclear Technology and Engineering Center (INTEC) is presented in Figure 2.

The major components of the ICDF are the disposal cells (landfill), an evaporation pond, and the Staging, Storage, Sizing, and Treatment Facility (SSSTF).[a] The disposal cells, including the buffer zone, will cover approximately 40 acres. The evaporation pond is composed of two individual cells with sufficient capacity for landfill leachate, precipitation directly into the pond, and additional inflows (i.e., washdown water for trucks and equipment, and purge/development water) (EDF-ER-271). The evaporation pond area, with a bottom area of 88,000 ft^2 and a depth of 64 inches, is designed to handle the worst-case conditions. Raw make-up water will be used to keep pond sediments submerged over the evaporation surface area allowed and the assumed pond inflow conditions (EDF-ER-271). The SSSTF will be a building designed to provide centralized receiving, inspection, and treatment necessary to stage, store, and treat incoming waste. This screening level ecological risk assessment (SLERA) addresses risk from modeled concentrations in both the disposal cells (landfill) and the evaporation pond.

The ICDF Complex will be a highly disturbed area during the construction and disposal of the contaminated soil. A 2-foot gravel layer will be added to the top of the contaminated soil after it is disposed of in the landfill. The addition of the 2-foot gravel layer will discourage most mammalian species from reaching or burrowing into the contaminated soil, and avian species exposure will be nearly eliminated. The ICDF complex will be fenced. While this will not eliminate all species from using the area, it will provide another deterrent to exposure.

The addition of the 10-foot biobarrier when the facility is ultimately closed should eliminate exposure to ecological receptors. None of the mammalian and plant species identified in the Subsurface Disposal Area (SDA) Biotic Data Compilation (EDF-ER-WAG7-76, which deals with the maximum burrowing depths of mammals and rooting depth of plants for species found at the INEEL), burrowed or had rooting depths exceeding the 10-foot depth the biobarrier will provide.

The evaporation pond will also be constructed to minimize exposure to receptors. The pond area and depth were determined based on the need to evaporate all ICDF landfill leachate, precipitation falling directly on the ponds, and additional flows totaling 30,000 gallons per month from March through November of each year from such sources as washdown water for trucks and equipment and purge/development water. The evaporative surface area was selected to allow evaporation of the average

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a. DOE-ID, 2001, "Staging, Storage, Sizing, and Treatment Facility Remedial Design/Remedial Action Work Plan (Draft)," (DOE/ID-10889), Revision Draft, July 2001.

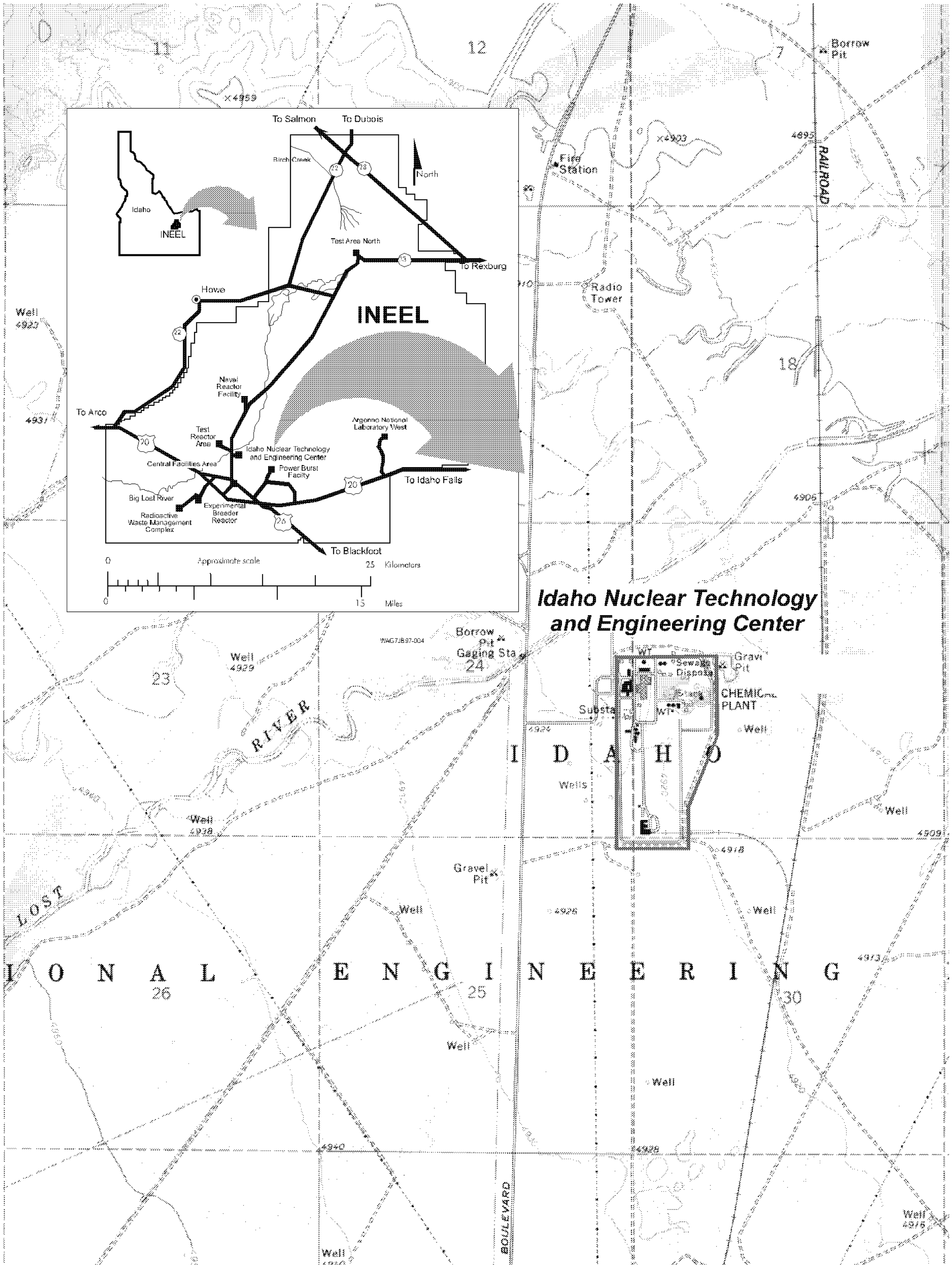

Figure 1. Location of INTEC within the INEEL.

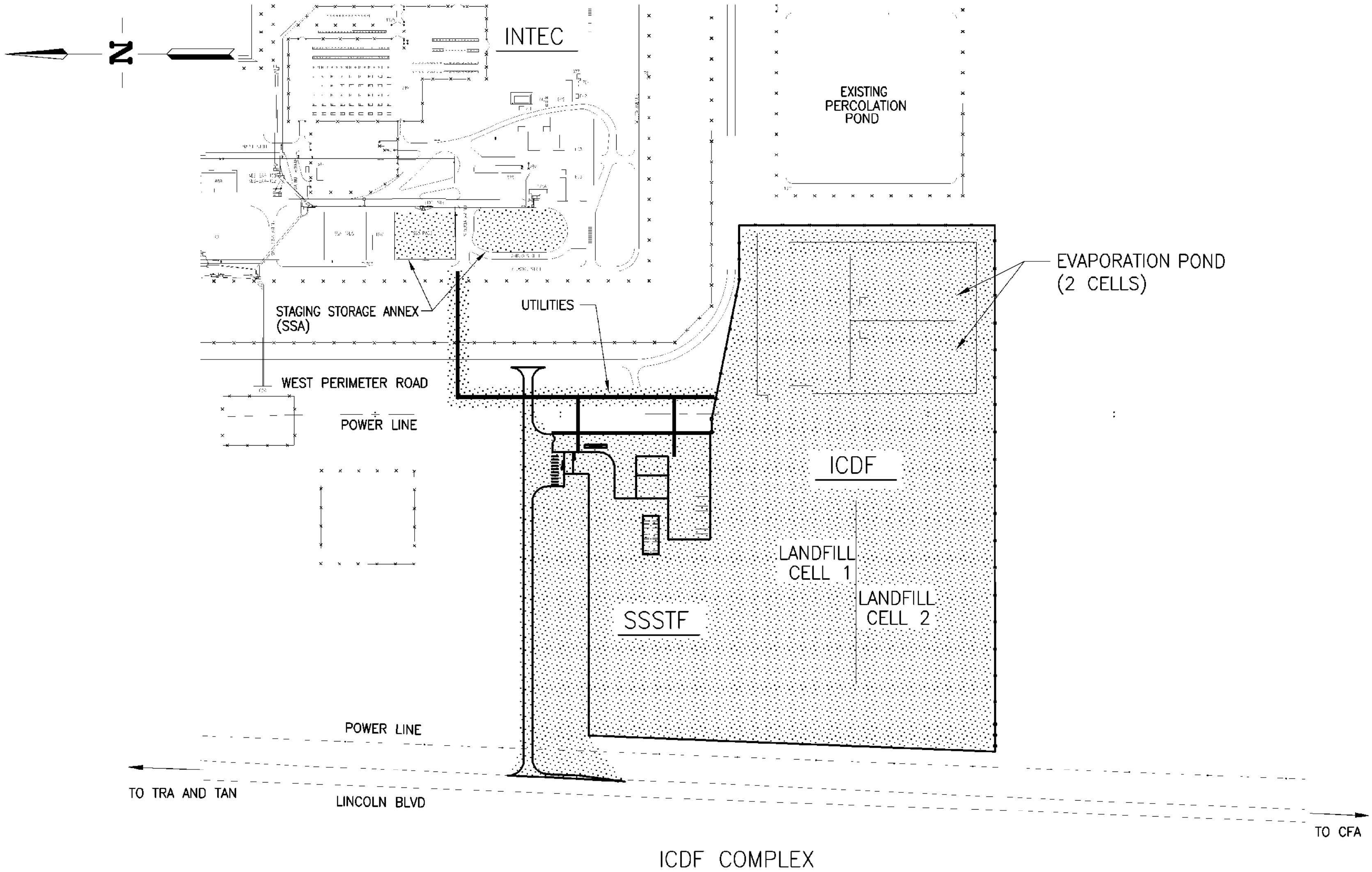

Figure 2. ICDF Complex layout and location relative to INTEC.

leachate production and precipitation onto the pond. Then the pond depth was selected to provide storage for excess leachate and precipitation that may accumulate if the worst-case leachate and precipitation were to occur for 3 years in a row following an average year.

The results of the computations showed that a total evaporation pond area bottom area of 88,000 ft^2 with depth of 64 in. will be adequate to handle the worst-case conditions. This depth provides a minimum freeboard of 24 in. Raw make-up water necessary to keep pond sediments submerged was found to be between 1 and 6 gallons per minute (gpm) over a period ranging from three to six months, depending upon the evaporation surface area allowed and the assumed pond inflow conditions (EDF-ER-271).

The evaporation ponds are double lined as described in Draft Evaporation Pond Lining System Equivalency Analysis (EDF-ER-312).[b] A fence will be constructed to minimize access to the pond by receptors and the sides will be maintained to minimize vegetation and habitat. In the INEEL site environment, any waterbody will be used by migrating waterfowl. Studies of the use of the TRA warm waste ponds indicate that although the pond will be used by migrating waterfowl, this use is expected to be minimal and the exposure to the receptor is expected to be 27 hours on average[c] (the receptor will continue its migration and not become a permanent resident at the pond). However, exposure to waterfowl was assessed in Appendix A and discussed in Section 6.

1. METHODS

The assessment was performed using the same basic methodology developed in the *Guidance Manual for Conducting Screening Level Ecological Risk Assessments at the INEL* (VanHorn, Hampton, and Morris 1995), subsequently referred to as the Guidance Manual. This methodology has been applied in INEEL ecological risk assessments (ERAs) for various WAGs, particularly those included in the WAG 3 Comprehensive RI/BRA and RI/FS (DOE-ID 1997, DOE-ID 1998). The methodology was specifically designed to follow the direction provided by the *Framework for Ecological Risk Assessment* (EPA 1992) and more recent EPA guidelines (EPA 1996a). This framework divides this SLERA process into three steps: problem formulation, analysis, and risk characterization.

In the problem formulation step, the interactions between the stressor characteristics, the ecosystem potentially at risk, and the ecological effects were defined (EPA 1992). Problem formulation results in characterization of stressors (i.e., identification of the contaminants, and their extents and concentrations), definition of assessment and measurement endpoints, and construction of the conceptual site model (CSM).

In the analysis step, the likelihood and significance of an adverse reaction from exposure to the stressor(s) were evaluated. The behavior and fate of the contaminants of potential concern (COPCs) in the terrestrial environment was presented in a general manner because no formal fate and transport modeling was conducted for this assessment. The ecological effects assessment includes a hazard evaluation and dose-response assessment, including a comprehensive review of toxicity data for contaminants to identify the nature and severity of toxic properties. Doses from subsurface contamination of the ICDF were

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b. EDF-ER-312, 2001, "Evaporation Pond Lining System Equivalency Analysis (60% Design Component) (Draft)," Rev. 0, Draft, Environmental Restoration, Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID, August 2001.

c. Warren, W. W., S. J. Majors, and R. C. Morris, 2001, "Waterfowl Uptake of Radionuclides from the TRA Evaporation Ponds and Potential Dose to Humans Consuming Them (Draft)," for the Department of Energy, Idaho Operations Office, February 2001.

developed and used to assess potential risk to receptors. Because no dose-based toxicological criteria exist for ecological receptors, it was necessary to choose appropriate toxicity reference values (TRVs) for the contaminants and apply them to functional groups at INEEL. A quantitative analysis was used, augmented by qualitative information and professional judgment.

The risk characterization step included two primary elements (EPA 1992). The first element is the development of an indication of the likelihood of adverse effects to ecological receptors. The second element is the presentation of the assessment results in a form that serves as input to the risk management process. To determine whether there is any indication of risk due to the modeled contaminant concentrations, a screening against INEEL-specific ecologically based screening levels (EBSLs) was included. Exceeding an EBSL concentration was considered an indicator of potential adverse effects.

1.1 Problem Formulation

Primary elements of the problem formulation step for the SLERA are described in the following sections. The problem formulation includes the definition of contaminant extents and concentrations (Section 1.1.1), characterization of the ecosystem (Section 1.1.2), identification of COPCs initially screened for subsequent quantitative evaluation (Section 1.1.3), definition of assessment endpoints and presentation of the CSM (Section 1.1.4).

1.1.1 Contamination Extent and Concentration

The major components of the ICDF Complex are the two landfill disposal cells, an evaporation pond with two cells, staging and storage areas, the decontamination facility, and the treatment facility. The landfill disposal cells are primarily for soils and other solid wastes and the evaporation ponds are for aqueous wastes. The SSSTF is designed to provide centralized receiving, staging, storage, packaging, and treatment from various INEEL Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remediation/removal and investigation sites prior to disposal in the ICDF landfill, the evaporation pond, or shipment off-Site. A major factor in the design of the ICDF landfill and the evaporation pond was the inventory of organic inorganic, and radionuclide contaminants (type, mass, and concentration) that will be disposed.

The IDCF Design Inventory (EDF-ER-264) contains the inventory of organic, inorganic and radionuclide contaminants (type, mass, and concentration) that will be deposited. This engineering design file (EDF) identifies a preliminary waste inventory that was used to assist in the design basis of the ICDF landfill and the evaporation pond. The design inventory is based primarily on the analytical data contained in the Design Inventory (EDF-ER-264) and in part on information in the CERCLA Waste Inventory Database (CWID), which is described in DOE-ID (2000) (referred to as the CWID report). Very conservative assumptions were made in these reports to provide an upper bound to ensure adequate facility design. Therefore, all data having detectable concentrations were used in development of the design inventory. For radionuclides, the concentrations in the design inventory were decayed to a common date of January 1, 2002. The design inventory for the ICDF includes waste from the remediation sites that have been identified in the Design Inventory EDF for disposal in the ICDF landfill. A total of 413,000 yd^3 (315,700 m^3) of contaminated soil and debris from 36 release sites has been identified for disposal in the ICDF landfill during its first 10 years of operation.

The Design Inventory EDF states that because much of the design inventory is conservatively estimated, it should not be used to approximate actual site conditions. However, it does provide an initial approximation of the wastes that may be disposed of in the ICDF landfill and it was used for the evaluation of the landfill in this risk assessment.

As discussed in the contaminant screening section, initial screening concentrations were based on the maximum contaminant masses presented in the Design Inventory (EDF-ER-264).

The modeled contaminant masses were divided by the entire volume capacity of the ICDF landfill (389,000 m^3) to yield the concentration (mg/kg) assumed throughout the entire landfill used in the risk assessment. The expected ICDF inventories and maximum concentrations (concentrations development can be found in later sections) for organic, inorganic, and radiological contaminants can be found in Tables 1–3.

Values for radiological contaminants were calculated using the following equation:

(activity of the contaminant) / (density (1500 kg/m3))*(soil volume (389,000 m3)
= concentration (pCi/g).

Values for inorganic and organic contaminants were calculated using the following equation:

(contaminant mass) / (density (1500 kg/m3))*(soil volume (389,000 m3) = concentration (mg/kg).

The IDCF Design Inventory (EDF-ER-264) was also the basis for the development of the concentrations of selected design inventory constituents in the ICDF landfill leachate water simulated over the 15-year operations period and documented in the EDF titled Leachate/Contaminant Reduction Time Study (Title I) (EDF-ER-274). The leachate/contaminant reduction time study was used to conservatively model the change in leachate concentration over time, as it is directed toward the evaporation pond. The results indicate less than 10% of the inventory masses of the most mobile constituents (iodine and technetium) are expected to be removed from the landfill during the operation period. The leachate concentrations from this study were summed over the 15-year period for those contaminants of concern and are presented in Tables 2 and 3. As stated, no organics were identified as concerns for the leachate in EDF-ER-274. These contaminants were evaluated using the approach for aquatic receptors as discussed below.

1.1.2 Ecosystem Characterization

The INEEL is located in a cool desert ecosystem characterized by shrub-steppe vegetative communities typical of the northern Great Basin and Columbia Plateau region. The surface of the INEEL is relatively flat with several prominent volcanic buttes and numerous basalt flows that provide important habitat for small and large mammals, reptiles, and some raptors. The shrub-steppe communities are dominated by sagebrush *(Artemisia* spp.) and provide habitat for sagebrush community species such as sage grouse *(Centrocercus urophasianus),* pronghorn antelope *(Antilocapra americana),* and sage sparrows *(Amphispiza belli).* Other communities include rabbitbrush *(Chrysothamnus* spp.), grasses and forbs, salt desert shrubs *(Atriplex* spp.), and exotic or weed species. Juniper woodlands are located near the buttes and in the northwest portion of INEEL. The juniper woodlands provide important habitat for raptors and large mammals. Limited riparian communities exist on the INEEL along intermittently flowing waters of the Big Lost River and Birch Creek drainages. Stream flow that reaches the INEEL flows to the Big Lost River playa or the Birch Creek playa, in which the flow is lost to evaporation and infiltration.

Table 1. Maximum contaminant masses and calculated concentrations for organics identified in the EDF-ER-264. (No organic leachates were identified in EDF-ER-274.)

Contaminant	Maximum Contaminant Mass (kg) EDF-ER-264	Maximum Concentration (mg/kg) Calculated from EDF-ER-264
1,1,1-Trichloroethane	7.40E+00	1.27E-02
1,1,2,2-Tetrachloroethane	2.30E-02	3.94E-05
1,1,2-Trichloroethane	1.10E-01	1.89E-04
1,1-Dichloroethane	1.10E+00	1.89E-03
1,1-Dichloroethene	7.00E-01	1.20E-03
1,2,4-Trichlorobenzene	5.40E+00	9.26E-03
1,2-Dichlorobenzene	5.40E+00	9.26E-03
1,2-Dichloroethane	2.50E-03	4.29E-06
1,2-Dichloroethene (total)	1.50E-01	2.57E-04
1,3-Dichlorobenzene	5.40E+00	9.26E-03
1,4-Dichlorobenzene	2.10E+02	3.60E-01
1,4-Dioxane	8.90E-03	1.53E-05
2,4,5-Trichlorophenol	2.10E+01	3.60E-02
2,4,6-Trichlorophenol	8.60E+00	1.47E-02
2,4-Dichlorophenol	1.00E+01	1.71E-02
2,4-Dimethylphenol	8.60E+00	1.47E-02
2,4-Dinitrophenol	2.40E+01	4.12E-02
2,4-Dinitrotoluene	5.40E+00	9.26E-03
2,6-Dinitrotoluene	9.80E+00	1.68E-02
2-Butanone	1.20E+01	2.06E-02
2-Chloronaphthalene	5.40E+00	9.26E-03
2-Chlorophenol	8.60E+00	1.47E-02
2-Hexanone	1.30E+00	2.23E-03
2-Methylnaphthalene	2.40E+02	4.12E-01
2-Methylphenol	9.80E+00	1.68E-02
2-Nitroaniline	1.30E+01	2.23E-02
2-Nitrophenol	8.60E+00	1.47E-02
3,3'-Dichlorobenzidine	5.40E+00	9.26E-03
3-Methyl Butanal	1.10E-01	1.89E-04
3-Nitroaniline	1.30E+01	2.23E-02

Table 1. (continued).

Contaminant	Maximum Contaminant Mass (kg) EDF-ER-264	Maximum Concentration (mg/kg) Calculated from EDF-ER-264
4,6-Dinitro-2-methylphenol	2.10E+01	3.60E-02
4-Bromophenyl-phenylether	5.40E+00	9.26E-03
4-Chloro-3-methylphenol	8.60E+00	1.47E-02
4-Chloroaniline	1.90E+01	3.26E-02
4-Chlorophenyl-phenylether	5.40E+00	9.26E-03
4-Methyl-2-Pentanone	1.40E+01	2.40E-02
4-Methylphenol	1.80E+01	3.09E-02
4-Nitroaniline	1.30E+01	2.23E-02
4-Nitrophenol	2.40E+01	4.12E-02
Acenaphthene	9.60E+01	1.65E-01
Acenaphthylene	9.80E+00	1.68E-02
Acetone	2.90E+02	4.97E-01
Acetonitrile	8.90E-03	1.53E-05
Acrolein	4.30E-03	7.37E-06
Acrylonitrile	4.30E-03	7.37E-06
Anthracene	1.50E+02	2.57E-01
Aramite	5.40E-02	9.26E-05
Aroclor-1016	3.60E+00	6.17E-03
Aroclor-1254	6.10E+01	1.05E-01
Aroclor-1260	3.40E+02	5.83E-01
Aroclor-1268	2.90E+01	4.97E-02
Benzene	2.90E+02	4.97E-01
Benzidine	1.40E-01	2.40E-04
Benzo(a)anthracene	1.20E+02	2.06E-01
Benzo(a)pyrene	5.00E+01	8.57E-02
Benzo(b)fluoranthene	8.50E+01	1.46E-01
Benzo(g,h,i)perylene	5.40E+00	9.26E-03
Benzo(k)fluoranthene	8.80E+00	1.51E-02
Benzoic acid	4.10E+00	7.03E-03
bis(2-Chloroethoxy)methane	5.40E+00	9.26E-03
bis(2-Chloroethyl)ether	5.40E+00	9.26E-03
bis(2-Chloroisopropyl)ether	5.40E+00	9.26E-03

Table 1. (continued).

Contaminant	Maximum Contaminant Mass (kg) EDF-ER-264	Maximum Concentration (mg/kg) Calculated from EDF-ER-264
bis(2-Ethylhexyl)phthalate	7.00E+01	1.20E-01
Butane,1,1,3,4-Tetrachloro-	3.70E+00	6.34E-03
Butylbenzylphthalate	3.20E+01	5.49E-02
Carbazole	1.50E+01	2.57E-02
Carbon Disulfide	2.20E+01	3.77E-02
Chlorobenzene	3.10E+00	5.32E-03
Chloroethane	1.40E-03	2.40E-06
Chloromethane	1.70E-01	2.91E-04
Chrysene	1.30E+02	2.23E-01
Decane, 3,4-Dimethyl	7.60E-02	1.30E-04
Diacetone alcohol	2.00E+03	3.43E+00
Dibenz(a,h)anthracene	5.40E+00	9.26E-03
Dibenzofuran	1.50E+02	2.57E-01
Diethylphthalate	5.40E+00	9.26E-03
Dimethyl Disulfide	1.40E+00	2.40E-03
Dimethylphthalate	5.40E+00	9.26E-03
Di-n-butylphthalate	1.10E+01	1.89E-02
Di-n-octylphthalate	1.20E+01	2.06E-02
Eicosane	1.30E+00	2.23E-03
Ethyl cyanide	8.90E-03	1.53E-05
Ethylbenzene	3.70E+01	6.34E-02
Famphur	2.80E-02	4.80E-05
Fluoranthene	3.60E+02	6.17E-01
Fluorene	8.70E+01	1.49E-01
Heptadecane, 2,6,10,15-Tetra	1.60E+00	2.74E-03
Hexachlorobenzene	5.40E+00	9.26E-03
Hexachlorobutadiene	9.80E+00	1.68E-02
Hexachlorocyclopentadiene	5.40E+00	9.26E-03
Hexachloroethane	5.40E+00	9.26E-03
Indeno(1,2,3-cd)pyrene	5.40E+00	9.26E-03
Isobutyl alcohol	8.90E-03	1.53E-05
Isophorone	5.40E+00	9.26E-03

Table 1. (continued).

Contaminant	Maximum Contaminant Mass (kg) EDF-ER-264	Maximum Concentration (mg/kg) Calculated from EDF-ER-264
Isopropyl Alcohol/2-propanol	1.00E+00	1.71E-03
Kepone	4.70E+01	8.06E-02
Mesityl oxide	4.00E+01	6.86E-02
Methyl Acetate	2.30E-01	3.94E-04
Methylene Chloride	4.00E+01	6.86E-02
Naphthalene	2.00E+02	3.43E-01
Nitrobenzene	5.40E+00	9.26E-03
N-Nitroso-di-n-propylamine	5.40E+00	9.26E-03
N-Nitrosodiphenylamine	5.40E+00	9.26E-03
Octane,2,3,7-Trimethyl	7.60E-02	1.30E-04
o-Toluenesulfonamide	2.40E+00	4.12E-03
Pentachlorophenol	2.60E+01	4.46E-02
Phenanthrene	5.50E+02	9.43E-01
Phenol	3.80E+01	6.52E-02
Phenol,2,6-Bis(1,1-Dimethyl)	1.90E+00	3.26E-03
p-Toluenesulfonamide	2.40E+00	4.12E-03
Pyrene	1.20E+02	2.06E-01
Styrene	4.90E-04	8.40E-07
Tetrachloroethene	4.60E+00	7.89E-03
Toluene	4.70E+02	8.06E-01
Tributylphosphate	1.70E+02	2.91E-01
Trichloroethene	3.40E+01	5.83E-02
Undecane,4,6-Dimethyl-	7.60E-02	1.30E-04
Xylene (ortho)	1.80E+00	3.09E-03
Xylene (total)	1.60E+03	2.74E+00

Table 2. Maximum contaminant masses and calculated concentrations for inorganics identified in the EDF-ER-264 (and leachates concentrations identified in EDF-ER-274).

	Maximum Contaminant Mass (kg) from EDF-ER-264	Maximum Concentration (mg/kg) Calculated from EDF-ER-264	Concentration (mg/L) Summed Over 15-Year Operational Period from EDF-ER-274
Aluminum	3.40E+06	5.83E+03	NA[a]
Antimony	2.80E+03	4.80E+00	NA
Arsenic	2.70E+03	4.63E+00	2.45E+01
Barium	8.50E+04	1.46E+02	NA
Beryllium	1.40E+02	2.40E-01	NA
Boron	8.70E+04	1.49E+02	6.50E+02
Cadmium	1.70E+03	2.91E+00	NA
Calcium	9.70E+06	1.66E+04	7.78E+01
Chloride	8.80E+02	1.51E+00	2.65E+02
Chromium III	1.90E+04	3.26E+01	NA
Cobalt	2.90E+03	4.97E+00	NA
Copper	1.40E+04	2.40E+01	NA
Cyanide	1.60E+02	2.74E-01	NA
Dysprosium	2.80E+04	4.80E+01	NA
Fluoride	1.80E+03	3.09E+00	As fluorine
Iron	4.90E+06	8.40E+03	NA
Lead	2.70E+04	4.63E+01	NA
Magnesium	2.10E+06	3.60E+03	NA
Manganese	9.80E+04	1.68E+02	4.00E+00
Mercury (inorganic)	4.50E+03	7.72E+00	NA
Molybdenum	4.80E+03	8.23E+00	NA
Nickel	9.30E+03	1.59E+01	NA
Nitrate	1.90E+03	3.26E+00	4.68E+02
Nitrate/Nitrite-N	1.10E+02	1.89E-01	NA
Nitrite	4.00E+00	6.86E-03	NA
Phosphorus	4.60E+04	7.89E+01	6.80E+00
Potassium	5.30E+05	9.09E+02	1.42E+00
Selenium	4.00E+02	6.86E-01	1.71E+00
Silver	4.70E+03	8.06E+00	NA
Sodium	1.00E+05	1.71E+02	NA

Table 2. (continued).

	Maximum Contaminant Mass (kg) from EDF-ER-264	Maximum Concentration (mg/kg) Calculated from EDF-ER-264	Concentration (mg/L) Summed Over 15-Year Operational Period from EDF-ER-274
Strontium	8.60E+03	1.47E+01	NA
Sulfate	9.70E+03	1.66E+01	5.97E+03
Sulfide	3.60E+05	6.17E+02	NA
Terbium	2.70E+05	4.63E+02	NA
Thallium	1.80E+02	3.09E-01	NA
Vanadium	1.00E+04	1.71E+01	5.56E+01
Ytterbium	9.20E+04	1.58E+02	NA
Zinc	9.90E+04	1.70E+02	5.00E-01
Zirconium	3.30E+04	5.66E+01	NA

NA indicates a leachate concentration was not calculated for this COPC.

Table 3. Maximum contaminant masses and calculated concentrations for radionuclides identified in the EDF-ER-264 (and leachates concentrations identified in EDF-ER-274).

	Half-Life in Years	Maximum Contaminant Mass (kg) from EDF-ER-264	Maximum Concentration (pCi/g) Calculated from EDF-ER-264[a]	Concentration (pCi/L) Summed Over 15-Year Operational Period from EDF-ER-274
Ac-225	2.74E-02	2.40E-08	4.11E-08	NA[b]
Ac-227	2.18E+01	9.70E-06	1.66E-05	NA
Ac-228	6.99E-04	7.20E-11	1.23E-10	NA
Ag-108	4.51E-06	1.80E-09	3.08E-09	NA
Ag-108m	1.27E+02	3.80E-01	6.51E-01	NA
Ag-109m	1.25E-06	2.30E-12	3.94E-12	NA
Ag-110	7.79E-07	2.50E-11	4.28E-11	NA
Ag-110m	6.84E-01	2.60E-09	4.45E-09	NA
Am-241	4.32E+02	1.10E+01	1.88E+01	NA
Am-242	1.83E-03	2.10E-05	3.60E-05	NA
Am-242m	1.52E+02	2.10E-05	3.60E-05	NA
Am-243	7.38E+03	1.60E-04	2.74E-04	NA
Am-246	4.75E-05	6.50E-26	1.11E-25	NA
At-217	1.01E-09	2.40E-08	4.11E-08	NA
Ba-137m	4.85E-06	1.10E+04	1.88E+04	NA
Be-10	1.60E+06	5.40E-07	9.25E-07	NA
Bi-210	1.37E-02	5.20E-07	8.90E-07	NA
Bi-211	4.05E-06	8.70E-06	1.49E-05	NA
Bi-212	1.15E-04	2.60E-04	4.45E-04	NA
Bi-214	3.78E-05	2.70E-06	4.62E-06	NA
Bk-249	8.76E-01	1.00E-21	1.71E-21	NA
Bk-250	3.68E-04	3.70E-26	6.34E-26	NA
C-14	5.73E+03	2.20E-05	3.77E-05	NA
Cd-109	1.27E+00	2.30E-12	3.94E-12	NA
Cd-113m	1.37E+01	7.70E-01	1.32E+00	NA
Cd-115m	1.22E-01	2.00E-54	3.42E-54	NA
Ce-141	8.90E-02	8.50E-72	1.46E-71	NA
Ce-144	7.78E-01	8.60E-04	1.47E-03	NA
Cf-249	3.51E+02	2.00E-16	3.42E-16	NA

Table 3. (continued).

	Half-Life in Years	Maximum Contaminant Mass (kg) from EDF-ER-264	Maximum Concentration (pCi/g) Calculated from EDF-ER-264[a]	Concentration (pCi/L) Summed Over 15-Year Operational Period from EDF-ER-274
Cf-250	1.31E+01	1.00E-16	1.71E-16	NA
Cf-251	9.00E+02	4.50E-19	7.71E-19	NA
Cf-252	2.64E+00	1.10E-20	1.88E-20	NA
Cm-241	9.58E-02	6.10E-81	1.04E-80	NA
Cm-242	4.47E-01	2.60E-17	4.45E-17	NA
Cm-243	2.85E+01	1.70E-06	2.91E-06	NA
Cm-244	1.81E+01	8.50E-04	1.46E-03	NA
Cm-245	8.50E+03	3.80E-08	6.51E-08	NA
Cm-246	4.75E+03	8.50E-10	1.46E-09	NA
Cm-247	1.56E+07	3.00E-16	5.14E-16	NA
Cm-248	3.39E+05	9.30E-17	1.59E-16	NA
Cm-250	6.90E+03	2.60E-25	4.45E-25	NA
Co-57	7.42E-01	1.70E-03	2.91E-03	NA
Co-58	1.94E-01	2.80E-17	4.79E-17	NA
Co-60	5.27E+00	9.20E+01	1.58E+02	NA
Cr-51	7.39E-02	1.10E-54	1.88E-54	NA
Cs-134	2.06E+00	5.30E+00	9.08E+00	NA
Cs-135	2.30E+06	1.70E-02	2.91E-02	NA
Cs-137	3.02E+01	1.20E+04	2.05E+04	NA
Eu-150	5.00E+00	8.20E-09	1.40E-08	NA
Eu-152	1.36E+01	4.60E+02	7.88E+02	NA
Eu-154	8.80E+00	3.90E+02	6.68E+02	NA
Eu-155	4.96E+00	8.40E+01	1.44E+02	NA
Fe-59	1.22E-01	2.10E-35	3.60E-35	NA
Fr-221	9.13E-06	2.40E-08	4.11E-08	NA
Fr-223	4.14E-05	1.30E-07	2.23E-07	NA
Gd-152	1.10E+14	1.30E-14	2.23E-14	NA
Gd-153	6.61E-01	9.50E-12	1.63E-11	NA
H-3	1.23E+01	2.30E+01	3.94E+01	NA
Hf-181	1.16E-01	3.70E-37	6.34E-37	NA

Table 3. (continued).

	Half-Life in Years	Maximum Contaminant Mass (kg) from EDF-ER-264	Maximum Concentration (pCi/g) Calculated from EDF-ER-264[a]	Concentration (pCi/L) Summed Over 15-Year Operational Period from EDF-ER-274
Ho-166m	1.20E+03	1.30E-06	2.23E-06	NA
I-129	1.57E+07	6.10E-01	1.04E+00	1.26E+05
In-114	2.28E-06	8.90E-55	1.52E-54	NA
In-114m	1.36E-01	9.40E-55	1.61E-54	NA
In-115	4.60E+15	2.70E-12	4.62E-12	NA
K-40	1.28E+09	9.10E-01	1.56E+00	NA
Kr-81	2.10E+05	2.50E-09	4.28E-09	NA
Kr-85	1.07E+01	5.50E+02	9.42E+02	NA
La-140	4.59E-03	1.30E-105	2.23E-105	NA
Mn-54	8.56E-01	9.10E-09	1.56E-08	NA
Nb-92	3.60E+07	3.00E-19	5.14E-19	NA
Nb-93m	1.46E+01	6.40E-03	1.10E-02	NA
Nb-94	2.03E+04	4.20E-06	7.19E-06	NA
Nb-95	9.60E-02	2.30E-33	3.94E-33	NA
Nb-95m	9.88E-03	8.70E-36	1.49E-35	NA
Nd-144	5.00E+15	1.50E-10	2.57E-10	NA
Np-235	1.08E+00	3.20E-11	5.48E-11	NA
Np-236	1.15E+05	3.30E-08	5.65E-08	NA
Np-237	2.14E+06	3.00E-01	5.14E-01	NA
Np-238	5.80E-03	1.00E-07	1.71E-07	NA
Np-239	6.45E-03	1.60E-04	2.74E-04	NA
Np-240	1.24E-04	1.30E-14	2.23E-14	NA
Np-240m	1.41E-05	1.20E-11	2.05E-11	NA
Pa-231	3.73E+04	3.30E-05	5.65E-05	NA
Pa-233	7.39E-02	2.10E-02	3.60E-02	NA
Pa-234	7.64E-04	1.30E-06	2.23E-06	NA
Pa-234m	2.22E-06	8.10E-04	1.39E-03	NA
Pb-209	3.71E-04	2.30E-08	3.94E-08	NA
Pb-210	2.23E+01	5.20E-07	8.90E-07	NA
Pb-211	6.86E-05	8.70E-06	1.49E-05	NA

Table 3. (continued).

	Half-Life in Years	Maximum Contaminant Mass (kg) from EDF-ER-264	Maximum Concentration (pCi/g) Calculated from EDF-ER-264[a]	Concentration (pCi/L) Summed Over 15-Year Operational Period from EDF-ER-274
Pb-212	1.21E-03	2.60E-04	4.45E-04	NA
Pb-214	5.10E-05	2.70E-06	4.62E-06	NA
Pd-107	6.50E+06	2.90E-03	4.97E-03	NA
Pm-146	5.53E+00	2.80E-03	4.79E-03	NA
Pm-147	2.62E+00	1.80E+02	3.08E+02	NA
Pm-148	1.47E-02	1.90E-59	3.25E-59	NA
Pm-148m	1.13E-01	3.90E-58	6.68E-58	NA
Po-210	3.79E-01	4.80E-07	8.22E-07	NA
Po-211	1.64E-08	3.20E-10	5.48E-10	NA
Po-212	9.44E-15	1.60E-04	2.74E-04	NA
Po-213	1.33E-13	2.10E-08	3.60E-08	NA
Po-214	5.20E-12	2.70E-06	4.62E-06	NA
Po-215	6.34E-11	8.70E-06	1.49E-05	NA
Po-216	4.63E-09	2.60E-04	4.45E-04	NA
Po-218	5.80E-06	2.70E-06	4.62E-06	NA
Pr-144	3.29E-05	8.40E-04	1.44E-03	NA
Pr-144m	1.37E-05	1.20E-05	2.05E-05	NA
Pu-236	2.85E+00	2.60E-06	4.45E-06	NA
Pu-237	1.24E-01	5.70E-59	9.76E-59	NA
Pu-238	8.78E+01	1.10E+02	1.88E+02	NA
Pu-239	2.41E+04	3.20E+00	5.48E+00	NA
Pu-240	6.57E+03	7.10E-01	1.22E+00	NA
Pu-241	1.44E+01	3.00E+01	5.14E+01	NA
Pu-242	3.76E+05	1.10E-04	1.88E-04	NA
Pu-243	5.65E-04	3.00E-16	5.14E-16	NA
Pu-244	8.26E+07	1.20E-11	2.05E-11	NA
Pu-246	2.97E-02	6.50E-26	1.11E-25	NA
Ra-222	1.20E-06	5.50E-117	9.42E-117	NA
Ra-223	3.13E-02	9.60E-06	1.64E-05	NA
Ra-224	9.91E-03	2.60E-04	4.45E-04	NA

Table 3. (continued).

	Half-Life in Years	Maximum Contaminant Mass (kg) from EDF-ER-264	Maximum Concentration (pCi/g) Calculated from EDF-ER-264[a]	Concentration (pCi/L) Summed Over 15-Year Operational Period from EDF-ER-274
Ra-225	4.05E-02	2.40E-08	4.11E-08	NA
Ra-226	1.60E+03	2.20E-01	3.77E-01	NA
Ra-228	5.75E+00	7.20E-11	1.23E-10	NA
Rb-87	4.73E+10	5.30E-06	9.08E-06	NA
Rh-102	2.90E+00	1.40E-05	2.40E-05	NA
Rh-103m	1.07E-04	1.30E-58	2.23E-58	NA
Rh-106	9.51E-07	5.40E-03	9.25E-03	NA
Rn-218	1.11E-09	6.00E-117	1.03E-116	NA
Rn-219	1.25E-07	9.60E-06	1.64E-05	NA
Rn-220	1.76E-06	2.60E-04	4.45E-04	NA
Rn-222	1.05E-02	2.90E-06	4.97E-06	NA
Ru-103	1.08E-01	9.50E-30	1.63E-29	NA
Ru-106	1.01E+00	5.80E-03	9.93E-03	NA
Sb-124	1.65E-01	9.80E-41	1.68E-40	NA
Sb-125	2.77E+00	4.40E+00	7.53E+00	NA
Sb-126	1.24E+01	9.80E-03	1.68E-02	NA
Sb-126m	3.61E-05	7.00E-02	1.20E-01	NA
Sc-46	2.30E-01	1.30E-20	2.23E-20	NA
Se-79	6.50E+04	7.90E-02	1.35E-01	NA
Sm-146	7.00E+07	2.00E-10	3.42E-10	NA
Sm-147	1.06E+11	1.90E-06	3.25E-06	NA
Sm-148	1.20E+13	4.80E-13	8.22E-13	NA
Sm-149	4.00E+14	2.40E-12	4.11E-12	NA
Sm-151	9.00E+01	1.60E+02	2.74E+02	NA
Sn-119m	8.02E-01	7.00E-08	1.20E-07	NA
Sn-121m	7.60E+01	1.30E-02	2.23E-02	NA
Sn-123	3.54E-01	4.00E-17	6.85E-17	NA
Sn-126	1.00E+05	7.00E-02	1.20E-01	NA
Sr-89	1.38E-01	2.80E-44	4.79E-44	NA
Sr-90	2.86E+01	1.10E+04	1.88E+04	NA

Table 3. (continued).

	Half-Life in Years	Maximum Contaminant Mass (kg) from EDF-ER-264	Maximum Concentration (pCi/g) Calculated from EDF-ER-264[a]	Concentration (pCi/L) Summed Over 15-Year Operational Period from EDF-ER-274
Tb-160	1.98E-01	1.50E-34	2.57E-34	NA
Tc-98	4.20E+06	8.40E-08	1.44E-07	NA
Tc-99	2.13E+05	2.70E+00	4.62E+00	2.50E+05
Te-123	1.00E+13	2.10E-15	3.60E-15	NA
Te-123m	3.28E-01	1.40E-23	2.40E-23	NA
Te-125m	1.59E-01	1.10E+00	1.88E+00	NA
Te-127	1.07E-03	4.40E-20	7.53E-20	NA
Te-127m	2.98E-01	4.50E-20	7.71E-20	NA
Te-129	1.32E-04	3.20E-71	5.48E-71	NA
Te-129m	9.20E-02	5.10E-71	8.73E-71	NA
Th-226	5.87E-05	1.00E-117	1.71E-117	NA
Th-227	5.13E-02	8.60E-06	1.47E-05	NA
Th-228	1.91E+00	1.60E-02	2.74E-02	NA
Th-229	7.34E+03	2.40E-08	4.11E-08	NA
Th-230	7.70E+04	8.20E-02	1.40E-01	NA
Th-231	2.91E-03	7.60E-02	1.30E-01	NA
Th-232	1.40E+10	7.40E-02	1.27E-01	NA
Th-234	6.60E-02	8.10E-04	1.39E-03	NA
Tl-207	9.07E-06	8.70E-06	1.49E-05	NA
Tl-208	5.80E-06	9.40E-05	1.61E-04	NA
Tl-209	4.18E-06	5.00E-10	8.56E-10	NA
Tm-170	3.52E-01	3.00E-26	5.14E-26	NA
Tm-171	1.92E+00	7.60E-13	1.30E-12	NA
U-232	7.20E+01	2.50E-04	4.28E-04	NA
U-233	1.59E+05	1.20E-05	2.05E-05	NA
U-234	2.44E+05	2.90E+00	4.97E+00	NA
U-235	7.04E+08	5.20E-02	8.90E-02	NA
U-236	2.34E+07	9.60E-02	1.64E-01	NA
U-238	4.47E+09	9.20E-01	1.58E+00	3.20E+02
U-240	1.61E-03	1.20E-11	2.05E-11	NA

Table 3. (continued).

	Half-Life in Years	Maximum Contaminant Mass (kg) from EDF-ER-264	Maximum Concentration (pCi/g) Calculated from EDF-ER-264[a]	Concentration (pCi/L) Summed Over 15-Year Operational Period from EDF-ER-274
Xe-127	9.97E-02	7.50E-73	1.28E-72	NA
Xe-131m	3.24E-02	1.30E-112	2.23E-112	NA
Y-90	7.31E-03	1.10E+04	1.88E+04	NA
Y-91	1.60E-01	2.00E-37	3.42E-37	NA
Zn-65	6.69E-01	1.30E-09	2.23E-09	NA
Zr-93	1.53E+06	4.10E-01	7.02E-01	NA
Zr-95	1.75E-01	1.40E-25	2.40E-25	NA

a. kg totals for radionuclides in EDF-ER-264 and EDF-ER-274 were converted to curies using published half-lives and atomic mass for each isotope.

b. NA indicates a leachate concentration was not calculated for this radiological COPC.

1.1.2.1 Abiotic Components. The INTEC facility is located on the alluvial plain of the Big Lost River. The main channel of the Big Lost River passes within 100 m of the northwest corner of INTEC facility fences along its route to the Sinks (approximately 18 km [11 mi] to the north).

The topography surrounding the INTEC is relatively flat. The soils surrounding the facilities are comprised primarily of Typic-Camborthids-Typic Calciorthids (TCC), Typic Torrifluvents (TTF) and Malm-Bondfarm-Matheson complex (432) soils.

Both TCC and TTF soils are alluvium, which are deposited by the Big Lost River. TTF soils are somewhat newer than TCC soils and are found in closer proximity to the river. The TCC soils are loams or silty loams over gravelly or sandy loams, and the surface is frequently hardened due to alkaline conditions. The TTF soils are also loams or sandy loams over gravelly subsoils. However, the gravels associated with TTF soils are finer and more frequently found on the surface than those of TCC soils. Both soil types are often dry and generally alkaline and saline, impermeable, erodible and have little organic accumulation in the upper layer (Olson, Jeppsen, and Lee 1995). Spring thaws and intense rainstorms may lead to significant soil erosion in these soil types.

1.1.2.2 Biotic Components. Sagebrush-steppe habitat on the INEEL supports a number of species including sage grouse, pronghorn, elk (*Cervus elaphus*), and waterfowl (all these are important game species). Grasslands provide habitat for species such as the western meadowlark (*Sturnella neglecta*) and mule deer (also a game species). Rock outcroppings support species such as bats, woodrats (*Neotoma cinerea*), and sensitive species such as the pygmy rabbit (*Brachylagus idahoensis*). The INTEC site is comprised of about 85 percent bare ground and about 13 percent facilities. However, buildings, lawns and ornamental vegetation, and wastewater treatment ponds at INTEC are utilized by a number of species such as waterfowl, raptors, rabbits, and bats. No areas of critical habitat (having significant value for supporting sensitive and/or unique plant and wildlife species and communities on site) are known to exist within the assessment area.

The flora and fauna existing in the assessment area are representative of those found across the INEEL and are described in the following subsections. Flora was determined using a vegetation map constructed for the INEEL using Landsat imagery and field measurements from vegetation plots (EG&G Idaho 1993). Fauna was characterized using a 1986 vertebrate survey performed on the INEEL (Reynolds et al. 1986) and data collected subsequent to that survey. The flora and fauna present in the assessment area have not been verified with a comprehensive field survey. However, information presented here is supported by previous field surveys and observations described in the WAG 3 Ecological Risk Assessment conducted as part of the OU 3-13 Comprehensive RI/FS (DOE-ID 1997).

1.1.2.3 Flora. The 15 INEEL vegetation cover classes defined using Landsat imagery data (Kramber et al. 1992) have been combined into eight cover classes applied for INEEL ERAs (VanHorn, Hampton, and Morris 1995). Six of the eight vegetation cover classes are represented in or near the assessment area: sagebrush-steppe on lava, sagebrush/rabbitbrush, grassland, salt desert shrub, playa-bare ground/disturbed, and juniper. The species composition for each of these classes is summarized in Table 4. Sagebrush-steppe on lava and sagebrush/rabbitbrush are the two predominant vegetation types found in the assessment area. The dominant vegetation species within these two communities is Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*). Grasslands present in the area are comprised primarily of wheat grasses (*Agropyron* spp., *Elymus* spp).

Table 4. Species composition near the ICDF assessment area and vegetation classes.

Vegetation Cover Class	INEEL Vegetation Cover Class	Dominant Species
Grasslands	Steppe Basin wildrye Grassland	*Leymus cinereus* *Descurainia sophia* *Sisymbrium altissimum* *Elymus lanceolatus* *Artemisia tridentata* ssp. *wyomingensis* *Elymus elymoides* *Chrysothamnus viscidiflorus*
Sagebrush/rabbitbrush	Sagebrush-steppe off lava Sagebrush-winterfat Sagebrush-rabbitbrush	*Artemisia tridentata* ssp. *wyomingensis* *Chrysothamnus viscidiflorus* *Bromus tectorum* *Sisymbrium altissimum* *Achnatherum hymenoides*
Salt desert shrubs	Salt desert shrub	*Atriplex nuttallii* *Atriplex canescens* *Atriplex confertifolia* *Krascheninnikovia lanata*
Sagebrush-steppe on lava	Sagebrush-steppe on lava	*Artemisia tridentata* ssp. *wyomingensis* *Achnatherum hymenoides* *Chrysothamnus viscidiflorus*
Playa-bare ground/disturbed areas	Playa-bare ground/gravel borrow pits, old fields, disturbed areas, seedings	*Kochia scoparia* *Salsola kali* *Artemisia tridentata* ssp. *wyomingensis* *Chrysothamnus viscidiflorus*

1.1.2.4 *Fauna.* The list of threatened or endangered species, sensitive species, and species of concern that may be found on the INEEL is presented in Table 5. None of the species are expected to be found within the assessment area. The list incorporates functional grouping as described in the Guidance Manual (VanHorn, Hampton, and Morris 1995). The functional grouping approach is designed to group similar species to aid in analyzing the effects of stressors on INEEL ecosystem components. The primary purpose of functional grouping is to apply existing data from one or more species within the group to assess the risk to the group as a whole. Functional groups are used to perform a limited evaluation of exposures for all potential receptors and provide a mechanism for focusing subsequent analyses on receptors that best characterize potential contaminant effects. Species characteristics including trophic level, breeding, and feeding locations were used to construct functional groups for INEEL species. Individual groups were assigned a unique identifier consisting of a one- or two-letter code to indicate taxon (A = amphibians, AV = birds, M = mammals, R = reptiles, I = insects), and a three-digit code derived from the combination of trophic category and feeding habitats. For example, AV122 represents the group of seed-eating (herbivorous) bird species whose feeding habitat is the terrestrial surface and/or understory. The trophic categories (first digit in three-digit code) are 1= herbivore, 2= insectivore, 3= carnivore, 4= omnivore, and 5= detrivore. The feeding habitat codes (second and third digits in three-digit code) are derived from the following:

1.0 Air

2.0 Terrestrial

- 2.1 Vegetation canopy
- 2.2 Surface/understory
- 2.3 Subsurface
- 2.4 Vertical habitat (man-made structures, cliffs, etc.)

3.0 Terrestrial/Aquatic Interface

- 3.1 Vegetation canopy
- 3.2 Surface/understory
- 3.3 Subsurface
- 3.4 Vertical habitat

4.0 Aquatic

- 4.1 Surface water
- 4.2 Water column
- 4.3 Bottom

The functional grouping methodology is described in detail in the Guidance Manual (VanHorn, Hampton, and Morris 1995).

Table 5. Threatened or endangered species, sensitive species, and species of concern that may be found on the INEEL.[a]

Common Name	Scientific Name	Federal Status[b,c]	State Status[c]	BLM Status[c]	USFS[f] Status[c]
Plants					
Lemhi milkvetch	*Astragalus aquilonius*	—	S	S	S
Painted milkvetch[e]	*Astragalus ceramicus var. apus*	3c	R	—	—
Plains milkvetch	*Astragalus gilviflorus*	NL	1	S	S
Winged-seed evening primrose	*Camissonia pterosperma*	NL	S	S	—
Nipple cactus[e]	*Coryphantha missouriensis*	NL	R	—	—
Spreading gilia	*Ipomopsis (=Gilia) polycladon*	NL	2	S	—
King's bladderpod	*Lesquerella kingii var. cobrensis*	—	M	—	—
Tree-like oxytheca[e]	*Oxytheca dendroidea*	NL	R	R	—
Inconspicuous phacelia[d]	*Phacelia inconspicua*	C2	SSC	S	S
Ute ladies' tresses[d]	*Spiranthes diluvialis*	LT	—	—	—
Puzzling halimolobos	*Halimolobos perplexa var. perplexa*	—	M	—	S
Birds					
Peregrine falcon	*Falco peregrinus*	3c	E	—	—
Merlin	*Falco columbarius*	NL	—	S	—
Gyrfalcon	*Falco rusticolus*	NL	SSC	S	—
Bald eagle	*Haliaeetus leucocephalus*	LT	T	—	—
Ferruginous hawk	*Buteo regalis*	C2	SSC	S	—
Black tern	*Chlidonias niger*	C2	—	—	—
Northern pygmy owl[d]	*Glaucidium gnoma*	—	SSC	—	—
Burrowing owl	*Athene cunicularia*	C2	—	S	—
Common loon	*Gavia immer*	—	SSC	—	—
American white pelican	*Pelicanus erythrorhynchos*	—	SSC	—	—
Great egret	*Casmerodius albus*	—	SSC	—	—
White-faced ibis	*Plegadis chihi*	C2	—	—	—
Long-billed curlew	*Numenius americanus*	3c	—	S	—
Loggerhead shrike	*Lanius ludovicianus*	C2	NL	S	—
Northern goshawk	*Accipiter gentilis*	C2	S	—	S
Swainson's hawk	*Buteo swainsoni*	—	—	S	—
Trumpeter swan	*Cygnus buccinator*	C2	SSC	S	S
Sharptailed grouse	*Tympanuchus phasianellus*	C2	—	S	S
Boreal owl	*Aegolius funereus*	—	SSC	S	S
Flammulated owl	*Otus flammeolus*	—	SSC	—	S

Table 5. (continued).

Common Name	Scientific Name	Federal Status[b,c]	State Status[c]	BLM Status[c]	USFS[f] Status[c]
Mammals					
Gray wolf[g]	*Canis lupus*	LE/XN	E	—	—
Pygmy rabbit	*Brachylagus (=Sylvilagus) idahoensis*	C2	SSC	S	—
Townsend's Western big-eared bat	*Corynorhinus (=Plecotus) townsendii*	C2	SSC	S	S
Merriam's shrew	*Sorex merriami*	—	S	—	—
Long-eared myotis	*Myotis evotis*	C2	—	—	—
Small-footed myotis	*Myotis ciliolabrum (=subulatus)*	C2	—	—	—
Western pipistrelle[d]	*Pipistrellus hesperus*	NL	SSC	—	—
Fringed myotis[d]	*Myotis thysanodes*	—	SSC	—	—
California myotis[d]	*Myotis californicus*	—	SSC	—	—
Reptiles and amphibians					
Northern sagebrush lizard	*Sceloporus graciosus*	C2	—	—	—
Ringneck snake[d]	*Diadophis punctatus*	C2	SSC	S	—
Night snake[e]	*Hypsiglena torquata*	—	—	R	—
Insects					
Idaho pointheaded grasshopper[d]	*Acrolophitus punchellus*	C2	SSC	—	—
Fish					
Shorthead sculpin[d]	*Cottus confusus*	—	SSC	—	—

a. This list was compiled from a letter from the U.S. Fish and Wildlife Service (USFWS) (1997) for threatened or endangered, and sensitive species listed by the Idaho Department of Fish and Game (IDFG) Conservation Data Center (CDC 1994 and IDFG web site 1997) and Radiological Environmental Sciences Laboratory documentation for the INEEL (Reynolds et al. 1986).

b. The USFWS no longer maintains a candidate (C2) species listing but addresses former listed species as "species of concern" (USFWS 1996). The C2 designation is retained here to maintain consistency between completed and ongoing INEEL ERA assessments.

c. Status codes: INPS = Idaho Native Plant Society; S = sensitive; 2 = State Priority 2 (INPS); 3c = no longer considered for listing; M = State of Idaho monitor species (INPS); NL = not listed; 1 = State Priority 1 (INPS); LE = listed endangered; E = endangered; LT = listed threatened; T = threatened; XN = experimental population, nonessential; SSC = species of special concern; and C2 = see item b, formerly Category 2 (defined in CDC 1994). BLM = Bureau of Land Management; R = removed from sensitive list (nonagency code added here for clarification).

d. No documented sightings at the INEEL; however, the ranges of these species overlap the INEEL and are included as possibilities to be considered for field surveys.

e. Recent updates that resulted from Idaho State Sensitive Species meetings (BLM, USFWS, INPS, and U.S. Forest Service [USFS]) - (INPS 1995, 1996, and 1997).

f. U.S. Forest Service (USFS) Region 4.

g. Anecdotal evidence indicates that isolated wolves may occur on the INEEL. However, no information exists to substantiate hunting or breeding on site (Morris 1998). Currently under consideration for de-listing.

The list of species potentially present in the assessment area was developed by updating 1986 data on the relative abundance, habitat use, and seasonal presence of fish, amphibians, reptiles, birds, and mammals recorded on the INEEL (Reynolds et al. 1986), and communicating with INEEL researchers and personnel conducting ecological studies since 1986. Fauna that are not supported by the existing habitat or that are rare or uncommon or otherwise unlikely to be found in the assessment area were not included in the literature search for species-specific exposure data and toxicity data. Those species are represented by the functional group with which they are associated. A complete list of species within individual functional groups, as well as those not included in the literature search can be found in VanHorn, Hampton, and Morris (1995). No surface hydrology exists to support fish, and they are therefore not evaluated.

Although some population studies have been conducted for cyclic rabbit and rodent populations, several game species (e.g., pronghorn, sage grouse), and raptors, no recent comprehensive studies have been conducted to assess either WAG-specific or INEEL-wide wildlife population status and/or trends with respect to contaminant effects.

Wildlife species present near or within the assessment area include birds, mammals, and reptiles that are associated with facilities, sagebrush-steppe, rock outcroppings, shrubs, and grasslands. The varying behaviors of these species include but are not limited to grazing and browsing on vegetation, burrowing and flying, and preying on insects and small mammals. If prey, such as a small mammal, becomes contaminated by ingesting contaminated soil or vegetation, and is then consumed by a predator, such as a ferruginous hawk, the contamination can be taken offsite when the hawk returns to its nest to feed nestlings.

The flora and fauna potentially present within the assessment area are combined into a simplified food web model. Variability in environmental conditions, such as population sizes or seasons, is not considered in this model, and a constant environment is assumed. Present near or at the site are decomposers, producers (vegetation), primary consumers or herbivores (e.g., rodents), secondary consumers or carnivores (e.g., snakes), and tertiary or top carnivores (e.g., raptors). These relationships were incorporated to identify direct and indirect exposure to contaminants for the CSM. This model depicts the possible transport of ICDF contaminants through the food web (Figure 3).

1.1.2.5 Threatened, Endangered and Sensitive Species. A list of threatened and endangered (T/E) and sensitive species was compiled from the U.S. Fish and Wildlife Service (Martin 1996), the Idaho Department of Fish and Game Conservation Data Center threatened, endangered, and sensitive species for the State of Idaho (CDC 1994); and Radiological and Environmental Sciences Laboratory (RESL) documentation for the INEEL (Reynolds et al. 1986). T/E and sensitive species, or species of concern, that could exist in the ICDF Complex assessment area are listed in Table 5.

Avian species include these six terrestrial species: the ferruginous hawk (*Buteo regalis*), the peregrine falcon (*Falco peregrinus*), the northern goshawk (*Accipiter gentilis*), the loggerhead shrike (*Lanius ludovicianus*), the burrowing owl (*Athene cunicularia*), and the bald eagle (*Haliaeetus leucocephalus*). Three avian aquatic species, the white-faced ibis (*Plegadis chihi*), the black tern (*Childonias niger*), and the trumpeter swan (*Cygnus buccinator*) may be found, although this is unlikely due to the disturbance and activity near the Complex in the assessment area.

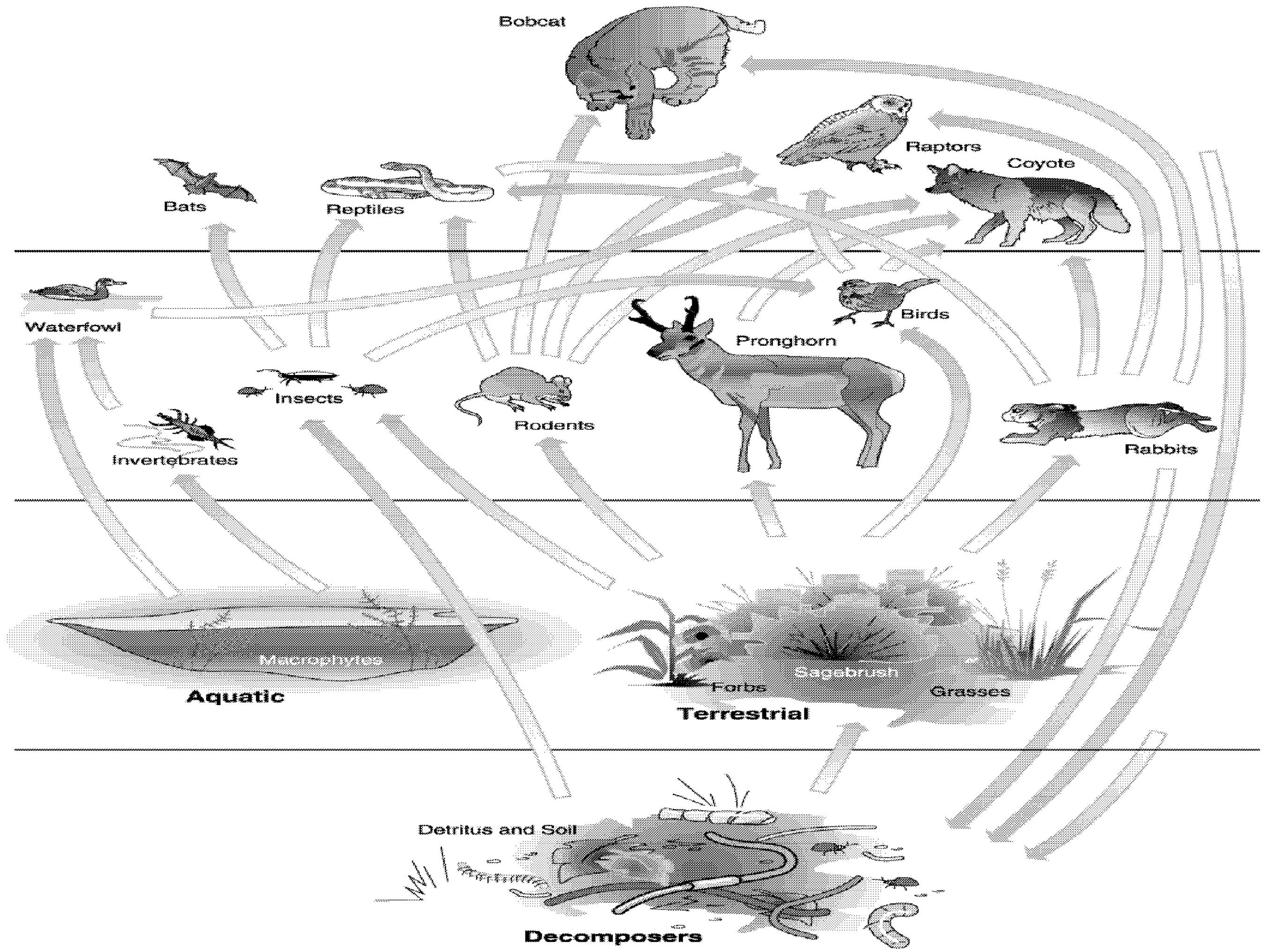

Figure 3. Simplified food web model from the INEEL.

Five mammalian species of concern potentially occur near the assessment: the pygmy rabbit (*Brachylagus idahoensis*), Townsend's western big-eared bat (*Plecotus townsendii*), long-eared myotis (*Myotis evotis*), small-footed myotis (*Myotis subulatus*) and gray wolf (*Canis lupus*). The occurrence of the gray wolf on the INEEL is unverified. However, because of anecdotal evidence (DOE-ID 1999) and the fact that the wolf is federally listed, the species is evaluated in the assessment.

The sagebrush lizard (*Sceloporous graciosus*) is the only reptile species of concern with a potential presence in the assessment area. No critical habitat, as defined in 40 CFR 300, is known to exist in the assessment area.

A survey to evaluate suitable habitat for T/E and species of concern in areas immediately surrounding INTEC was conducted in 1996 (DOE-ID 1999).

In 1996, field surveys were conducted in the areas surrounding WAG 3 facilities to assess the presence and use of those areas by T/E species or other species of special concern (i.e., species formerly designated as C2). The survey findings have been documented in reports that include survey protocols and results for WAG 3 (DOE-ID 1999). Specific information collected and reported for each T/E or species of special concern includes:

- Date and conditions under which the surveys were conducted
- Area encompassed by the surveys (global positioning system [GPS] mapping where practical)
- GPS locations for observed habitat, sign, and species sighted (where practicable)
- Habitat description, the proximity to WAG or site, and an estimate of whether contaminated sites or areas are within the home range of members of the species in question
- Species presence, abundance, current site use, past site use (historical sightings or surveys), and anticipated site use (professional judgment)
- An estimated site or area population (where possible).

1.1.3 Pathways of Contaminant Migration and Exposure

Contaminated subsurface soil represents the major source of possible contaminant exposure for ecological components within the ICDF assessment area. Surface soil and surface water pathways were not analyzed as part of this assessment due to the nature of the planned ICDF landfill process of burying the contaminated soil beneath two feet of gravel. Table 6 summarizes the exposure media for INEEL functional groups.

Table 6. Summary of ICDF exposure media and ingestion routes for INEEL functional groups (ingestion of surface water from the evaporation pond is modeled for all groups).

Receptor	Subsurface Soils	Vegetation	Prey Consumption: Invertebrates	Prey Consumption: Mammals	Prey Consumption: Birds
Avian herbivores (AV122)	—	X	—	—	—
Avian insectivores (AV210A)	—	—	X	—	—
Avian insectivores (AV222)	—	—	X	—	—
Avian insectivores (AV232)	—	—	X	—	—
Avian carnivores (AV310)	—	—	—	X	X
Northern goshawk	—	—	—	X	X
Peregrine falcon	—	—	—	X	—
Avian carnivores (AV322)	—	—	—	X	—
Bald eagle	—	—	—	X	—
Ferruginous hawk	—	—	—	X	—
Loggerhead shrike	—	—	—	X	X
Avian carnivores (AV322A) Burrowing owl	X	—	X	X	—
Avian omnivores (AV422)	—	X	X	X	X
Mammalian herbivores (M122)	—	X	—	—	—
Mammalian herbivores (M122A)	X	X	—	—	—
Pygmy rabbit	X	X	—	—	—
Mammalian insectivores (M210A)	—	—	X	—	—
Townsend's western big-eared bat	—	—	X	—	—
Small-footed myotis	—	—	X	—	—
Long-eared myotis	—	—	X	—	—
Mammalian insectivores (M222) Merriam's shrew	X	—	X	—	—
Mammalian carnivore (M322)	X	—	—	X	—
Mammalian omnivores (M422)	X	X	X	—	—
Reptilian carnivores (R322)	X	—	—	X	—
Plants	X	—	—	—	—

1.1.4 Assessment Endpoints

Assessment endpoints are "formal expressions of the actual environmental values that are to be protected" (Suter 1989). Assessment endpoints developed for this SLERA are presented on Table 7. The endpoints were developed around the protection of INEEL biota represented by functional groups and individual T/E and sensitive species known to exist at WAG 3 and identified as having potential for exposure to COPCs. Each T/E and sensitive species with the potential for exposure is addressed individually in the risk analysis, whereas potential effects to other receptors of concern are dealt with at the functional group level. Assessment endpoints defined for the SLERA reflect INEEL-wide hazard/policy goals discussed in the Guidance Manual (VanHorn, Hampton, and Morris 1995) and incorporate the suggested criteria for developing assessment endpoints, including ecological relevance and policy goals (EPA 1992, Suter 1993).

These assessment endpoints are the focus for SLERA risk characterization, and they link the measurement endpoints to the SLERA goals. The primary objective of this SLERA is to identify COPCs and levels of those contaminants that represent potential risk to ecological components in the assessment area. Consequently, toxic effects to ecological components as a result of exposure to COPCs were considered a primary concern for biota. Although adverse effects due to physical stressors are also of concern in evaluating potential risks to INEEL ecological components, these effects are not addressed by this SLERA.

Table 7. Summary of assessment endpoints for ICDF.[a]

Management Goal	ICDF SLERA Assessment Endpoint	Indicator of Risk
Maintain INEEL T/E individuals and populations by limiting exposure to organic, inorganic, and radionuclide contamination.	Survival of T/E individuals and reproductive success of T/E populations: northern goshawk, burrowing owl, ferruginous hawk, pygmy rabbit, Townsend's western big-eared bat, long-eared myotis, small-footed myotis, and sagebrush lizard	HI target exceeded
Maintain abundance and diversity of INEEL native biota by limiting exposure to organic, inorganic, and radionuclide contamination.	Survival and growth of native vegetation	Plant toxicity screening benchmark exceeded
	Survival and reproduction of wildlife populations (identified in the site conceptual model: waterfowl, small mammals, large mammals, song birds, raptors, top predators; represented by functional groups)	HI target exceeded

a. Suter (1993).

1.1.5 Measurement Endpoint Selection

This section describes the selection of measurement endpoints for the ICDF SLERA. Measurement endpoints are measurable responses of ecological receptors to contaminants that can be related to SLERA assessment endpoints. For this SLERA, ecological components (flora and fauna) inside the assessment area were not measured or surveyed directly. Rather, published references were used as the primary sources of ecological and toxicological data from which measurement endpoints were derived. Values extracted from these references were used to calculate doses for all ecological receptors and to develop TRVs for contaminants.

Table 8 summarizes the measurement endpoints developed to address ICDF Complex SLERA assessment endpoints. Quantified critical exposure levels (QCELs) and adjustment factors (AFs) were constructed from the literature to develop appropriate TRVs for receptors associated with ICDF contaminant pathways. Criteria for development of these TRVs are discussed in the Guidance Manual (VanHorn, Hampton, and Morris 1995). In general, the criteria incorporate the requirements for appropriate measurement endpoints, including relevance to an assessment endpoint, applicability to the route of exposure, use of existing data, and consideration of scale (VanHorn, Hampton, and Morris 1995).

Values for species dietary habits, home ranges, site use, exposure duration (ED), soil ingestion, food digestion, and body weights for the representative species are documented in Appendix D of the OU 10-04 Comprehensive RI/FS work plan (DOE-ID 1999). The exposure-point concentrations of contaminants in each media were used to calculate dose for each affected receptor.

The measurement endpoints are the modeled dose as compared to the EBSLs for each contaminant for each individual receptor or functional group. The modeled dose was divided by the TRV to produce hazard quotients (HQs) for each contaminant and receptor of concern. The HQs are then summed by receptor to determine a hazard index (HI). The HI is ultimately used to measure whether the assessment endpoints have been attained, that is, survival and reproductive success are ensured for the receptor groups being assessed (HIsare less than target value for all receptors for each contaminant).

1.1.6 Conceptual Site Model

The pathways/exposure models for surface soil, subsurface soil, and surface water were integrated to produce a general sitewide conceptual model that is used to tentatively represent the ICDF Complex shown in Figure 4. This model reflects both direct (as discussed in previous sections) and indirect (i.e., predation) receptor exposure pathways for ICDF COPCs. The CSM is a general sitewide model and does not show an exact representation of the ICDF Complex. The INEEL CSM is shown only to depict possible pathways that may occur at the ICDF Complex.

Table 8. Summary of ICDF SLERA endpoints.

ICDF Assessment Endpoint	Ecological Component	Functional Group (Other Groups Represented)	Measurement Species (Toxicity Reference Value Test Species)
No indication of possible effects on T/E and C2 individuals and populations as a result of contaminant exposure	Pygmy rabbit	M122A (M123)	Rat, mouse/meadow vole (M122A), and deer mouse (M422)
	Gray wolf	M322	Dog, mouse (M422)
	Peregrine falcon, and northern goshawk	AV310	Chicken, goshawk, and American kestrel/red-tailed hawk (AV322)
	Ferruginous hawk, loggerhead shrike, bald eagle, and burrowing owl	AV322, AV322A	Chicken, goshawk, and American kestrel/red-tailed hawk (AV322)
	Sagebrush lizard	R222	None located
	Bats	M210, M210A	Rat, mouse/meadow vole (M122A), and deer mouse (M422)
No indication of possible effects on native vegetation communities as a result of contaminant exposure	Vegetation	Sagebrush and bunchgrass	Bush beans and crop plants
No indication of possible effects on wildlife populations as a result of contaminant exposure (represented by functional groups identified in the site conceptual model: small mammals, large mammals, song birds, raptors, and top predators, invertebrates)	Small mammals	M422, M122A (M222, M123)	Rat, mouse/meadow vole (M122A), and deer mouse (M422)
	Mammalian carnivores and omnivores	M422A, M322	Rat, mouse, dog, cat, and mink/fox
	Mammalian herbivores	M121, M122, M122A	Rat, mouse, and mule deer/pronghorn
	Avian carnivores	AV322, AV322A, M122A	Goshawk (AV310) and American kestrel/red-tailed hawk (AV322)
	Avian herbivores	AV121, AV122	Chicken, pheasant, quail, and passerines/sharp-tailed and ruffed grouse
	Avian insectivore	AV210, AV222 (AV210A, AV221, AV22A)	Chicken, pheasant, quail, passerines/American robin (AV222), and cliff swallow (AV210A)
	Avian omnivores	AV422	Chicken, pheasant, turkey, black, mallard
	Mammalian insectivore	M210A (M210)	Rat, mouse/meadow vole (M122A), and deer mouse (M422)
	Reptiles	R222, R322	Western racer (none located)
	Invertebrates	Phytophagous, saprophagous, and entomophagous	Unidentified

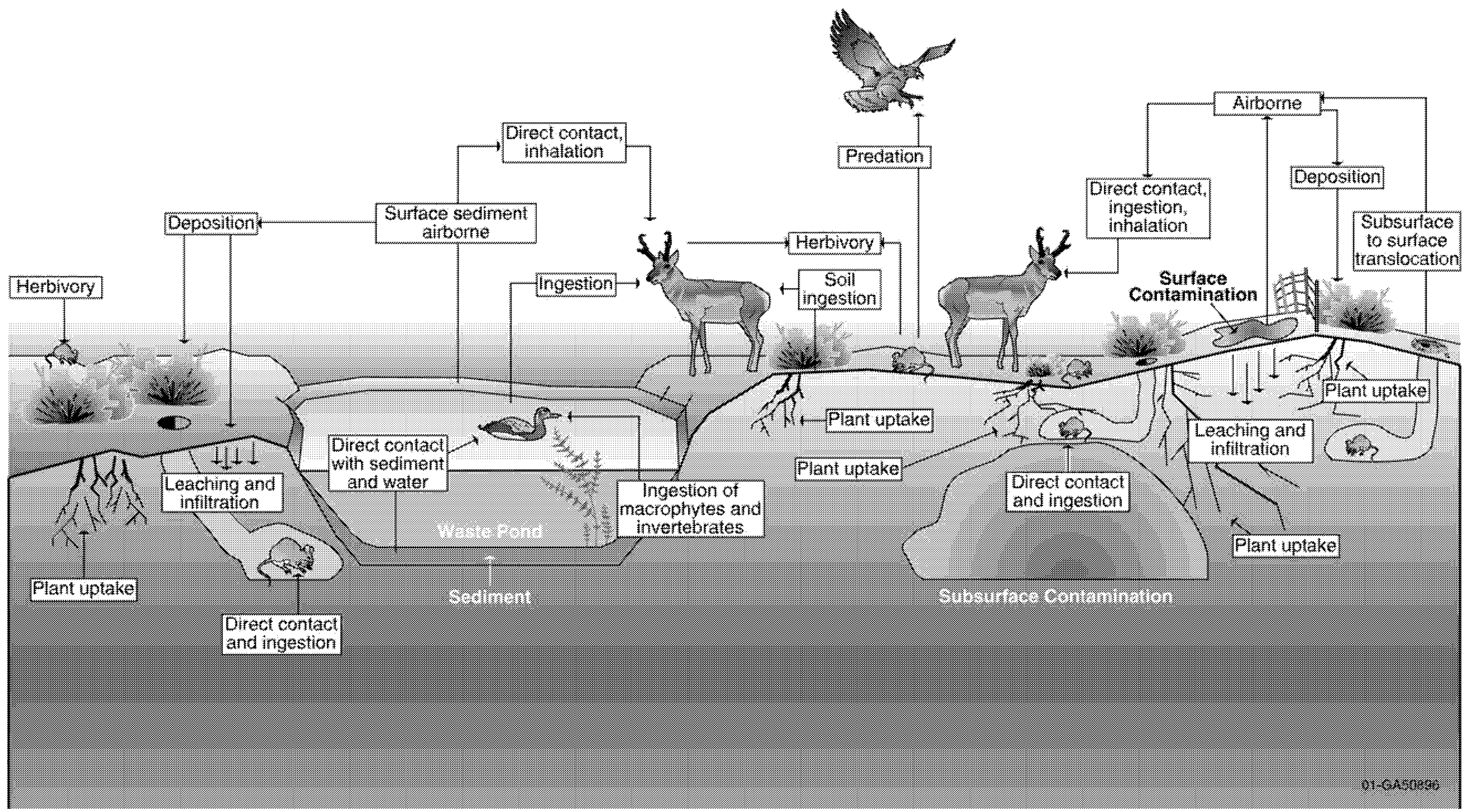

Figure 4. INEEL ecological conceptual site model showing pathways that may be present at the ICDF Complex.